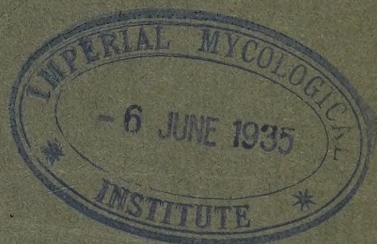


1719

REPORT

ON THE



British West Indies Central

Sugar Cane Breeding

Station

FOR THE

Period Ending September 30th 1934.

REPORT

ON THE

British West Indies Central

Cane Breeding

Station

FOR THE

Period Ending September 30th 1934.



Digitized by the Internet Archive
in 2025

Report on the Central Cane Breeding Station for the Period Ending September 30th 1934.

CONTENTS.

	PAGE.
Historical	1
Organization	2
Advisory Committee	3
Report of the Geneticist	4
Report of the Assistant Botanist	14
Expenditure	20

BRITISH WEST INDIES SUGAR CANE BREEDING STATION.

ADVISORY COMMITTEE.

Chairman—R. W. R. MILLER, B.A., (Camb), A.I.C., Dip. Agric. (Cantab).
Director of Science and Agriculture, Barbados.

Members—SIR GEOFFREY EVANS, Kt., M.A., C.I.E., Principal of the Imperial
College of Tropical Agriculture.

Hon. E. J. WORTLEY, O.B.E., Director of Agriculture, Trinidad.

A. C. BARNES, B.Sc., F.I.C., A.M.I.Ch.E., Director of Agriculture,
Jamaica.

G. A. JONES, Dip. Agric. (Bangor), Commissioner of Agriculture
of the Agricultural Advisory Department of the Imperial College
of Tropical Agriculture.

Geneticist—A. E. S. McINTOSH, B.Sc., Ph.D., (Edin).

Asst. Botanist—G. C. STEVENSON, B.A., A.I.C.T.A.

Field Assistant—J. M. CAVE, D.I.C.T.A.

Statistical Clerk—A. D. HERBERT, D.I.C.T.A.

Report on the British West Indies Central Sugar Cane Breeding Station.

FOR THE PERIOD ENDING SEPTEMBER 30TH, 1934.

Historical.

Since before the end of the last century, Barbados has relied on its own seedling sugar canes rather than upon importations from other Colonies, and the work of Harrison and Bovell, especially the latter, is still respected throughout all sugar producing countries.

Under the conditions by which the cane seedlings were originally raised it was impossible to produce seedlings by controlled crosses in any considerable numbers, although such a successful variety as B.H.10(12) was amongst those produced by this method.

With the absorption of the old Agricultural Department in the new Department of Science and Agriculture in 1925, the technique of sugar cane breeding was gradually placed on a less empirical footing so that nowadays a regular supply of high grade sugar cane seedlings can be guaranteed rather than the previous occasional fortuitous discovery of a promising variety.

As long as the Colony of Barbados was responsible for the entire expenditure on cane breeding, only Barbados' own problems were investigated and thus many problems of great interest and of the highest importance to other sugar cane growing colonies in the British West Indies were left untouched.

In 1930 the replies to a questionnaire showed that over 77,500 acres of Barbados canes were being planted annually by other British West Indian colonies as compared with an annual planting of 35,000 acres by Barbados, and it seemed obvious that the other Islands would be better benefited by having their individual problems investigated rather than being forced to plant those of the canes, which had been produced for Barbados, and which appeared most suited to their own conditions.

In August, 1931, the Imperial Sugar Cane Research Conference at the Colonial Office recommended as follows:—

“.....We recommend that, if our proposals are generally approved, “the Government of Barbados should be invited to meet two-thirds of “the annual cost of the Station, and that the Empire Marketing Board “should be asked to provide for the next three years a sum of the “order of £3,000 per annum, to meet the remaining one-third, on the “understanding that the position will be reviewed at the end of the “second year after the inauguration of the Central Station, in “order to consider what financial assistance can then be provided “in the form of block grants from the other Colonial Governments “interested.....”

The opportunity of the visit of the Agricultural Adviser to the Secretary of State in 1932 was taken to put the scheme on a practical basis, with the result that the Empire Marketing Board granted £300 for capital and £2,000 for recurrent expenditure for the twelve months ending September 30th, 1933, provided the expenditure on cane breeding by Barbados was maintained at its previous figure of approximately £5,500 per annum.

On the closing down of the Empire Marketing Board, the finance was arranged for by the Colonial Development Fund with grants of £455 and £410 respectively for capital and £1,795 and £1,840 for recurrent expenditure for the years ending September 30th, 1934 and 1935.

The British West Indies Central Sugar Cane Breeding Station, therefore, is financed until September 30th, 1935, by the British Government (£2,250 per annum), and by Barbados (approximately £5,500 per annum), and it is suggested that eventually the grant from the British Government and a part of the expenditure incurred by Barbados should become a charge on those Islands of the British West Indies which are interested in the production of sugar cane. (The present cost would not be more than three pence per ton of sugar exported).

Organisation.

The work of the British West Indies Central Sugar Cane Breeding Station, then, has carried on and extended the sugar cane breeding work which was formerly being performed by the Department of Science and Agriculture in Barbados by enlarging the previous work and by enabling entirely new problems to be investigated. In the first category may be mentioned the increase in the number of seedlings planted out in the field by over sixty per cent. (from six thousand to ten thousand), by the increase in the number of experimental variety and select seedling trials conducted in Barbados, and by the extension of experiments on gumming disease.

The study of the root systems of the different types of sugar cane promises to develop into an exceedingly important piece of work. A report on the preliminary studies is being published shortly.

The Director of the Department of Science and Agriculture is the executive officer in charge of the cane breeding station and the policy of the station is in the hands of the Advisory Committee which is comprised of representatives of the Imperial College of Tropical Agriculture, the Department of Agriculture, Trinidad, the Advisory Department of the Imperial College in so far as it represents the Windward and Leeward Islands, the Department of Agriculture, Jamaica, with the Director of Agriculture, Barbados, as Chairman.

With the grant from the Empire Marketing Board and its continuation by the Colonial Development Fund the following appointments have been made:—

G. C. Stevenson, B.A., A.I.C.T.A.,	Assistant Botanist 12th December, 1932.
J. M. Cave, D.I.C.T.A.	Field Assistant 1st December, 1932.
H. L. Manning, D.I.C.T.A.	Statistical Clerk 16th December, 1932 to 14th March, 1934.
J. N. W. Niccolls,	Statistical Clerk 1st April, 1934 to 31st May, 1934.
L. H. Atkinson,	Statistical Clerk 1st June, 1934 to 31st August, 1934.
A. D. Herbert, D.I.C.T.A.	Statistical Clerk 1st September, 1934.

Mr. Manning was appointed Assistant Agricultural Officer in Montserrat as from the 15th of March, 1934. It is desired to record the high appreciation of this Officer's work while in the service of the Cane Breeding Station.

Advisory Committee.

The Advisory Committee held its first meeting in Barbados in January, 1933, and its second in November, 1933, and its third meeting in Trinidad in May, 1934. Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State, was able to attend the second meeting, and the value of his advice and experience was much appreciated by the Committee.

The Advisory Committee has proved of the greatest assistance in running the station and its deliberations have covered a very wide range of subjects connected with sugar cane breeding in the British West Indies.

REPORT OF THE GENETICIST FOR THE PERIOD ENDING SEPTEMBER 30TH, 1934.

I. Introduction.

In this, the first annual report of the British West Indies Central Sugar Cane Breeding Station, it is necessary to indicate briefly the development of the sugar cane breeding work from the comparatively recent period when it was devoted to the production of seedlings for Barbados only, to the present transitional period during which it has been necessary to expand the breeding and testing work with a view to satisfying the seedling requirements of the British West Indies as a whole.

The extension of the cane breeding section of the Barbados Department of Science and Agriculture which was necessary in order that it function as the Central Cane Breeding Station for the West Indies, took place in the autumn of 1932.

It is pre-supposed that the methods employed in producing sugar cane seedlings for Barbados should form the basis for seedling production for the other Islands. Any necessary additions to these methods concern those areas in the British West Indies whose seedling requirements are, for one or other reasons, distinct from those in Barbados.

The seedling requirements for Barbados are briefly considered below. The requirements for areas in the British West Indies whose conditions resemble those in Barbados are considered to be approximately similar and are not at present thought to require distinct methods in seedling production. On the other hand the existence of sugar cane areas in the British West Indies with conditions distinct from those in Barbados, necessitate the use of special breeding material and distinct methods of testing the seedlings. These are outlined in this report.

II. Sugar Cane Breeding for Barbados.

The seedling requirements of this Colony have been noted from time to time in Reports and Journals of the Barbados Department of Science and Agriculture and need not be discussed in detail here. It is, perhaps, sufficient to note the salient features influencing the growth and development of sugar cane in Barbados, and which, consequently, are the principal factors influencing the seedling requirements.

The principal ecological factors, with their grouping to form areas of considered different seedling requirements are shown in diagrammatic form here:—

Shallow Black Coral Limestone Soils . . .	Low Rainfall	(1)
	Low—Intermediate Rainfall	(2)

Transitional Shallow Black to Shallow Red Coral Limestone Soils ..	Intermediate Rainfall	(3)
Shallow Red Coral Limestone Soils ..	{ Intermediate—High Rainfall	(4)
	{ High Rainfall	(5)
Deep Valley Black Coral Limestone soils	Low—Intermediate Rainfall	(6)
Shallow Sandy Coral Limestone Soils..	Low—Intermediate Rainfall	(7)

Variety planting recommendations are based on the results of trials carried out in representative places of each of the above categories.

The annual rainfall varies from an average of 45 inches (low rainfall) to 75 inches (high rainfall). There is a dry season on the average from January to May. Planting is done in November and December, and reaping from January to May or June. Plant canes are, therefore, on an average, 16 months old when cut and ratoons 13½ months.

The soils are intrinsically fertile, although lacking in depth. It may be on account of the latter that canes dry readily during the crop season.

With the object of extending the crop period, and in addition to increasing cane tonnages, the breeding work aims at producing seedlings suited, by virtue of early ripening or by their retaining weight during the crop season, to early and late reaping respectively.

A further factor influencing the selection of seedlings is their resistance to gumming disease (*Bacterium vascularum*, (Cobb), Grieg-Smith). An outline of the gumming disease resistance tests is given by the Assistant Botanist.

Other general desiderata in seedlings for Barbados are high sucrose content in cane, good milling properties, good ratooning ability, high trash production, good growth habit (and so ease in cutting), and freedom from or little arrowing.

Prior to the extension of the cane breeding work performed by the Barbados Department of Science and Agriculture into that of the Central Cane Breeding Station, it may be stated briefly, the essential breeding work consisted in hybridization; and an improvement of the medium for initial seedling selection—the first year seedlings—had been effected by a system of testing populations from known crosses. Moreover, first year selected seedlings were tested under conditions of high and low rainfall and early and late reaping, and each subsequent selection tested in its appropriate ecological areas. Gumming disease resistance of each was noted during the second year of trial and each was thoroughly tested in addition by ratooning trials, milling and chemical analysis, and by close observations at reaping.

The majority of the seedlings planted in first year seedling trials comprised noble cane crosses. Considerable time and space was also devoted to the breed-

ing and testing of seedlings from Java glagah nobilisations of the P.O.J. series crossed with Barbados varieties, and, in addition, seedlings derived by back-crossing selections from these to Barbados varieties. The chief object in making these Java-Barbados crosses was to incorporate the growth vigour, ratooning and disease resistance properties of the Java varieties, while retaining in the selected crosses the virtues of the Barbados varieties.

Indications from the breeding work were that the most promising seedling material consisted of crosses from Barbados varieties. It was found, in regard to the abovementioned further nobilisations of the P.O.J. varieties by Barbados varieties, that their selected crosses persistently showed too many of the undesirable characteristics of the wild ancestor (*S. spontaneum*) of the P.O.J. varieties employed.

As will be shown later, it appears highly desirable to pursue lines of nobilising wild *Saccharum* species, and, in order to avoid selecting the fast growing short-season, nobilised seedlings (which probably exhibit these characteristics on account of a high proportion of wild cane blood), it is proposed to grow first year seedlings over a longer period—16 months—(previously 11 months). It is anticipated that selections after such a growing period will be more suited to the nature and duration of the growing seasons in the British West Indies.

III. The Sugar Cane Seedling Requirements of the British West Indies.

On the creation of the Central Cane Breeding Station it was necessary to review the sugar cane growing conditions in the British West Indies and to determine their sugar cane seedling requirements. Accordingly, the writer visited in turn St. Kitts, Trinidad, Antigua, St. Lucia, Jamaica and Grenada during 1933 and 1934. Reports on these visits have already been published.* As a result of the findings from these visits it was evident that, while the conditions in many areas were in the main similar to those in Barbados, there were distinct seedling requirements for others.

The areas with conditions distinct from those in Barbados require separate consideration from the point of view of breeding, testing and selecting seedlings. The outstanding cases in this respect are noted here under the headings of the factor considered most influential in deciding the seedling requirements,

SOIL.

In parts of the sugar cane growing areas in the British West Indies, e.g. in Trinidad, Jamaica, and Antigua, occur types of soils which are, for various causes, inherently infertile and which, as a result, are incapable of producing satisfactory plant cane and more particularly ratoon crops of noble varieties.

* McIntosh, A. E. S. Report on the Sugar Cane Breeding Problems of Antigua, Trinidad and St. Kitts. British West Indies Sugar Cane Breeding Station, Bull. No. 1, September, 1933.
 " " Report on the Sugar Cane Variety Problems in St. Lucia. Ibid. Bull. No. 2, June, 1934.
 " " Report on a Visit to Jamaica. Ibid. Bull. No. 3, September, 1934.
 " " Report on a Visit to Grenada. Ibid. Bull. No. 4, November, 1934.

In Trinidad, the red weathering clays in the Naparima district can produce successfully crops of Uba only.

In the Trelawny district of Jamaica occurs a peculiar type of intrinsically infertile soil recognised by the presence of dark, shot-like concretions of iron oxide, known as 'shot'. Noble cane varieties have been unsuccessful in these soils.

Soils with high salt content and consequent inability to produce good crops of noble cane varieties occur in parts of southern Jamaica and in Antigua.

Prolonged water-logging is a feature of some cane areas in Trinidad and Jamaica. This is coupled with a markedly acid soil, especially in Trinidad. Under such conditions thick cane varieties have so far been unsuccessful.

DISEASES.

Mosaic Disease. This major sugar cane disease is at present uncontrollable in many parts of Jamaica and necessitates the planting of mosaic disease immune varieties of inferior commercial value. The problem here is to breed for seedlings with commercial immunity to mosaic coupled with good commercial qualities.

PESTS.

The two major sugar cane pests in the British West Indies are the small moth borer (*Diatraea saccharalis*) and froghopper (*Tomaspis saccharina*). The former, it is hoped, will be controlled by biological means. No parasite, however, has been discovered which might effect a biological control of the latter, and, in addition, no satisfactory control measures by cultural methods have been discovered. In a memorandum submitted by the Trinidad Sugar Cane Investigation Committee, it was shown that there exist degrees of varietal resistance to froghopper. This has suggested breeding for resistance to froghopper.

IV. Schemes for Breeding and Selecting Seedlings for B.W.I. Sugar Cane Areas. *

(1) *Sugar Cane Breeding for Areas Approximately Similar to Barbados.*

For all areas which are considered to possess conditions approximately similar to those in Barbados, the breeding and seedling selection procedures are essentially those employed for the latter. The details of these can be found in recent publications of the Barbados Department of Science and Agriculture.

Under present arrangements those seedlings which reach an advanced stage in the routine series of tests against the commercial varieties in Barbados will be despatched, after liberation from the Central Quarantine Station in Trinidad,

* A detailed account of these will be published in the near future by the Central Cane Breeding Station.

to the Colonies possessing such areas, and there multiplied for inclusion in advanced trials. This scheme does not necessarily involve any expansion in the breeding policy.

(2) *Sugar Cane Breeding for Areas Whose Seedling Requirements are Distinct from Those in Barbados.*

In regard to the procedure for those areas with requirements distinct from Barbados, the following lines of work are being pursued, on the assumption that it is highly improbable that noble cane seedlings will be best suited commercially to such areas. This has prompted several schemes of nobilisation of wild species or their near derivatives.

It is well known that nobilisations of glagah *Saccharum spontaneum* tend to inherit its commercial immunity to mosaic disease. In Trinidad, it has been noted that nobilisations of *S. spontaneum* and *S. barberi* possess, on an average, much higher resistance than the noble varieties to froghopper attack and destruction. Uba (*S. sinense*) is the only variety which will grow successfully in poor soils in parts of Trinidad and Jamaica. Varieties of the wild species, *S. barberi*, and *S. spontaneum*, are reputed to withstand successfully prolonged periods of waterlogging and poor soil aeration.

In all these respects noble canes have been shown to be comparative failures. On the other hand, Barbados noble cane varieties are well adapted to the growing seasons in the British West Indies and, at the same time, possess high juice and excellent milling qualities.

The policy is, therefore, by nobilisation, to combine the desired qualities of the wild canes and the noble canes.

While persisting in lines of nobilisation already carried out in Barbados, it is the intention to begin nobilising original varieties of wild cane and their close derivatives. The object of the latter is to select at an early stage nobilisations suited to the growing seasons of the British West Indies. In this respect the writer is of the opinion that the nobilisation work done in Java has evolved types suited to the Java growing season which is short (12—13 months), and presents a continuous growing period, and not to that of the British West Indies, which is long (15—18 months), and generally interrupted in the early stages by a long dry season. By going back to a nobilisation of the original wild varieties, it is considered probable that, from the early nobilisations, better further breeding material will be obtained.

The list of wild canes to be used in this aspect of the nobilisation work is noted below. The object of using so many at the start is to allow for incompatible types and to determine, for those which when crossed with Barbados varieties produce seedlings, which of them provide the most promising material for further nobilisation.

<i>Saccharum spontaneum</i>	..	..	Gehra Bon, Dacca, Local.
<i>S. spontaneum</i> , 1st nobilised Java 'glagah'	..	..	Kassoer, Synthetic Kassoer.
<i>S. spontaneum</i> , 1st nobilised N. Celebes 'tabongo'	..	..	Toledo.
<i>S. barberi</i>	..	..	Chunnee, Hemja, Hathooni.
<i>S. sinense</i>	..	..	Uba (India), Uba (Hawaii).

In addition, P.O.J. varieties of the chunnee and glagah nobilisation series and Coimbatore varieties of both chunnee and Indian *S. spontaneum* nobilisations are being further nobilised with Barbados varieties.

In the selection of nobilised seedlings, strict precautions are to be made to select types which, while possessing the virtues of the wild canes, do not possess their undesirable short season features. It is hoped to avoid the latter, at least in great measure, by extending the period of first year trial to the duration of the British West Indies growing season, i.e. approximately 16 months.

In regard to further selection and trial of seedlings for these areas, it is evident that, prior to selection, each must show some general minimum standard of appearance and performance in Barbados. One, or, at most, two seasons' trials will suffice for this purpose.

It then remains to despatch the selected seedlings for a further series of trials in areas for which they have been bred and recommended. The data from these trials, while serving the immediate purpose of determining whether any are of commercial value, will also help to guide future breeding work.

In regard to the latter aspect, it is hoped to get valuable information from the root system studies now being carried out at the Station and reported on below by the Assistant Botanist.

V. Sugar Cane Breeding, Seedling Selection and Trials—Season 1933-34.

These have already been reported in detail*. A summary of the work is given here.

(1) Sugar Cane Breeding—B.35' Series.

Sugar cane breeding was carried out at Lion Castle Estate during October, November and December, 1933.

* McIntosh, A. E. S., 1934. Report of the Geneticist for the year 1933-34. Jour. Barbados Dept. Sci. & Agric., Vol. 3, No. 4.

All seedlings subsequently planted were derived from crossing. The crosses made are presented below:—

A. Crosses between noble varieties (*S. officinarum*)

(i) Proven Crosses —

Ba.11569 x S.C.12/4.
 „ x B.417.
 „ x Ba.8069.
 „ x B.H.10(12).
 „ x Ba.6032.
 „ x B.606.
 „ x B.603.

(ii) Experimental Crosses (Trial Marriages):—

(a) Barbados Crosses —

Ba.11569 x W. Transparent.
 „ x B.376.
 „ x Burke.
 „ x B.694.
 B.376 x S.C. 12/4.
 *Rock Hall x B.H.10(12).
 *Red Un-
 known x „

(b) Barbados varieties crossed with imported noble varieties—

Ba.11569 x D.1135.
 „ x Q.813.
 „ x H.Q.409.

B. Nobilisations of *S. spontaneum*.

- (i) nobilisations of P.O.J's 2364, 2725, 2878.
- (ii) Back-crosses of previously selected seedlings of such crosses to Barbados varieties.
- (iii) crosses between such seedlings and P.O.J. 2878.

In all, forty-four crosses under this head were made.

C. Nobilisations of *S. barberi*:—

Ba.11569 x P.O.J. 234.
 P.O.J.213 x B.H.10(12).
 Co.213 x „
 Co.213 x B.391.

*These are old Barbados varieties which have not been identified.

D. Crosses involving the production of seedlings with blood of all three species.

Ba.11569 x Co.281.
 B. 3215 x Co.281.
 Ba.11569 x Co.290.
 Co.290 x B.H.10(12).

(II.) *Seedling Raising and Planting Out—B.35' Series.*

The following crosses gave poor germinations:—P.O.J.213 x B.H.10(12), Co.213 x B.391 and Co.213 x B.H.10(12).

In all, 20,000 seedlings were potted during January and February, 1934. This included 12,000 seedlings of nine proven crosses and 8,000 seedlings of fifty-two experimental crosses.

The seedlings were planted in the field at the end of April; the lay-out being similar to that employed in previous years.

The numbers and allocations were as follows:—

A. Proven Crosses.

(1) for early reaping during crop—five crosses—3,224.
 (2) for late reaping during crop—four crosses—3,415.

B. Experimental Crosses.

Forty-six crosses, plus one standard proven cross—Ba.11569 x B.H.10(12) —3,424.

Grand Total	..	..	10,063.
-------------	----	----	---------

These seedlings will be reaped in 1935, and selections for further trial and for use as parents will comprise the B.35' series of seedlings.

(III) *Results of Reaping First Year Seedlings—B.34' Series.*

During the 1934 crop the three categories of these seedlings were reaped at separate times thus:—

(a) proven crosses—early group; reaped in January.
 (b) proven crosses—late group; reaped at the end of April.
 (c) experimental crosses; reaped in March.

The final selections were made as follows:—

Proven Crosses—early group	..	..	..	30.
„ „ —late group	..	..	..	56.
Total	..	..	..	86.
Experimental Crosses	..	..	..	59.

The fifty-nine selected seedlings from the experimental cross group were divided into three lots:—

- (i) seven seedlings of noble variety parentage.
- (ii) thirty-eight seedlings derived from a wide range of parental types.
- (iii) fourteen seedlings derived from P.O.J.'s 2364, 2725, 2878, and Co.281 crossed with several Barbados male parents.

Seedlings from the first lot will be included with, and undergo the usual series of trials in Barbados as the selections from the proven crosses already noted. Those in the second lot are to be tested in a second year trial during the season 1934-36; this in order to determine their possible commercial value for the British West Indies sugar cane growing areas. The seedlings in the third lot are retained essentially for breeding purposes.

(IV). Notes on Minor Selection Plots—B.33' Series.

Prior to the inclusion of selected seedlings in this series in the routine second year trials, minor selections are made annually both at Codrington Experiment Station and Dodds Estate.

(V). Second Year Seedling Trials—B.32' Series.

The late group of the B.32' Series was retained in minor selection plots.

The early group of seedlings was tested against standard commercial varieties at Dodds and Lemon Arbor estates during the season 1932-34.

The lay-out, the methods of reaping, selecting and statistically analysing the results were essentially similar to previous years' second year trials.

Of the twenty-seven seedlings tested, three were selected for further trials.

Two of these—B.3216 and B.3239—are to be further tested in routine Select Seedling Trials. The other—B.3234, performed so well at the higher rainfall station—Lemon Arbor—as to justify its direct promotion to variety trials; chiefly as a competitor of B.H.10(12).

(VI) Select Seedling Trials—B.30' Series.

For these trials, which were designed to test second year selections of the B.30' series of seedlings against the existing standard varieties, six stations were selected to give a representative range of soil and climatic conditions.

The seedlings were—B.3011, B.3013, B.3038, B.3063, B.3078 and the standard varieties—B.H.10(12), B.726, B.891, Ba.11569, B.2935. P.O.J. 2878 was also included for a second time.

The results of these trials showed that B.3038, B.3063, and B.3078 were inferior and were thus discarded. B.3011 showed sufficient promise to be re-included in a future series of these trials, while B.3013 performed so well as to warrant inclusion in variety trials.

The latter variety gave good cane yields, an excellent juice quality, retained its weight during crop, was easily reaped and showed high resistance to gumming disease. It shows promise for certain areas in the British West Indies.

P.O.J. 2878 again failed to do sufficiently well to be considered as a commercial variety in Barbados. It is retained for breeding purposes.

(VII). *Variety Trials—B.29' Series.*

These were laid out on a small field scale to test the value of B.2935 when compared with its competitors B.726, B.891, and more especially Ba.11569 in the lower and lower-intermediate rainfall districts of the Island.

A summary of the yields is given on Table I:—

TABLE I.

Plantation Number	Variety and Yield in Tons per acre				Mean Yield of all varieties
	B. 2935	Ba.11569	B. 891	B. 726	
6	51.17	..	36.72	40.73	42.87
8	48.34	36.85	38.44	..	41.21
10	45.84	37.28	36.00	..	39.71
2	41.02	..	35.20	39.80	38.67
7	42.46	33.02	38.84	..	38.11
4	40.21	34.42	..	32.73	35.79
3	39.83	32.37	31.21	..	34.47
5	37.42	29.19	29.09	..	31.90
11	35.56	26.82	..	28.33	30.24
1	33.39	30.52	25.80	..	29.90
9	32.75	27.24	23.61	..	27.87
Mean Yield of Individual Varieties.	40.73	31.97	32.77	35.40	35.52

The conclusions in regard to this new variety are that it is the best plant cane variety for lower and lower-intermediate rainfall districts and that further trials are necessary to test its ratooning powers under such conditions.

It is highly probable that B.2935 will be suited to low rainfall districts in

St. Kitts, Antigua, Vieux Fort in St. Lucia, and Grand Anse in Grenada. Consignments of plant material have already been despatched to those Islands, and it is already incorporated in trials in appropriate areas in St. Kitts and Antigua. At present, it is not considered to be suited on any large scale to Trinidad or Jamaica.

(VI) Notes on Growth Measurements.

The nature of and findings from these measurements have been reported in a recent publication.*

Growth measurements are now performed as a routine measure on seedlings during their third season of testing. They have been found to be valuable in determining the growth type of each seedling, and, as a consequence, in allocating each, should it perform well in general, to its most suited environment in its further and larger trials.

During the season under review, growth measurements were made for the five selected seedlings of the B.31' series, and in addition, for the standard varieties B.2935, B.726, B.H.10(12), on Sealy Seedling (an old Barbados variety with a peculiar growth type) and the Coimbatore variety—Co. 290.

REPORT OF THE ASSISTANT BOTANIST.

I. STUDIES ON ROOT DEVELOPMENT OF THE SUGAR CANE.

(1) Introduction.

Investigations into the root development of the sugar cane in Barbados, which were begun in December, 1932, are being carried out with two main objects in view, namely, (1) to determine the growth and development of the root systems of varieties, and, so far as is possible in Barbados, to note to what extent environmental conditions (mainly those of the soil) may in these respects bring about differential responses by varieties, and (2) to determine, for different environments, the relationships between the growth and development of the above-ground parts of varieties and those of their root systems.

It is hoped that findings from the work will have application in the selection of parents for breeding purposes, and in the allocation of resultant seedlings to distinct environments by the recognition of particular root system types.

The restricted range of soil types and the actual shallowness of the soil in Barbados might limit information acquired in respect to differential responses by variety root systems, and, in view of this, greater attention will be paid in the near future to investigations under the second heading above.

* McIntosh, A. E. S., 1934. Sugar Cane Growth Measurements in Barbados Dept. Sci. & Agri., Barbados Agricultural Journal, Vol. 3, No. 1, pp. 1—29.

(ii) Root System Investigations, 1933-34.

Following is a short account of the first investigation, made in 1933-34. This investigation has been reported in detail elsewhere.*

(a) *Objects of the Investigation.*

The objects of the investigation were to obtain information on the fundamental features of root growth, and on the varietal differences in root development exhibited under one environment.

The investigation involved four examinations of the root systems of the five varieties:—B.H.10(12), Ba.11569, B.726, P.O.J.2878 and Co.281, made at approximately four-month intervals during the growth of the stools.

(b) *Experimental Area, Material and Methods.*

A piece of land was selected at Codrington Experiment Station, in the low rainfall district of Barbados (average annual precipitation approximately 48 inches) on the characteristic black coral limestone soil. The uniformity of the soil profile in the area was established by preliminary auger borings.

The plants were grown from single-eye cuttings, which were transplanted from boxes to the field in January, 1933. The growth of the above-ground parts was noted by systematic recording of stool compositions at fortnightly intervals, and root development was investigated at four times:—first, in May 1933, during the dry season; second in August–September, 1933, during the rainy season when the canes were making their maximum growth; third, in December, 1933–January 1934, when rainfall was decreasing and cane growth had almost ceased; and fourth, in May 1934, at the end of the dry crop season.

Root development was investigated by three distinct methods: (1) direct examination of varietal root systems in profile. This was done by digging trenches near the stool bases to a depth of $2\frac{1}{2}$ to 3 feet (governed by the contour of the coral rock below), and exposing the root systems by means of a regulated water spray followed by drawing to scale on squared paper; and (2) qualitative and quantitative examinations of root distribution by weighing air-dried roots recovered from soil samples from three six-inch soil horizons, and treating them with running water in a sieve of 2-mm. mesh, and (3), examination of stools removed from the field with adhering roots, for features of root production from the cane bases.

(c) *Results of Examinations.*

The first examination was made at the end of the dry season, when soil moisture, particularly in the surface soil, was low. Roots showed a pronounced tendency to grow downwards vertically or obliquely. They were white and

* Stevenson, G. C., & McIntosh, A. E. S. Investigations into the Root Development of the Sugar Cane in Barbados. (1) Root Development in Several Varieties under One Environment. B.W.I. C.S.C.B.S. Bull. 5.

turgid for 2"—4" behind the root tips, and successively older portions of the roots showed areas of shrivelled cortex, which was brown, and areas of dead cortex, which was black and sometimes sloughed off. Root branches were sparingly produced except where root ends had been injured or restricted in growth, in which cases profuse branching was frequently noticed. The surface six-inch soil layer was low in root content, and there was a marked increase in root mass and a wider distribution in successively lower layers. Varietal differences were not marked at this time, and consisted essentially in amount rather than in distribution. Root mass was greatest in the variety Co.281, and stool examinations showed that this feature was clearly related to the large number of tillers present in the stools.

At the second examination, tillers and canes were making rapid growth, and soil moisture was abundant in the surface layers. Primary roots had tended to grow horizontally near the soil surface and profuse branching took place in this horizon. The vertical distribution of roots had completely altered, such that the total weight of roots in each layer was now approximately similar. Individual primary roots appeared to pass through their developmental stages more quickly than at the first examination. Absorbing roots and non-absorbing roots were considered separately in the quantitative examination. Non-absorbing roots were shown to have a similar distribution to total roots at the first examination, and would appear to be a late stage of the latter. Such old roots were not dead, however, as was shown by the presence of turgid root-ends in the lower soil layers, and apparently functional steles below the dead and black cortical layers. Fine, fibrous roots, produced after the shrivelling of the cortex of primary roots and branches, were found to exhibit profuse root-hair development, and were present now in greater numbers than at the first examination. It would appear that absorption takes place largely by these fibrous roots, although a certain amount of absorption may occur directly through the living cortical cells of root ends of main roots and branches, where root hairs are only scantily produced. Varietal differences in root distribution were more marked at this time than at the first examination. They are described in detail in the publication referred to above. Outstanding among these varietal differences are the great increase in root development, especially in respect of fibrous roots, in the variety B.726, and the tendency for a highly superficial development of the absorbing roots in P.O.J. 2878.

At the third examination, a further increase in root content of the top six inch soil layer was seen, and this horizon was now well filled with roots. Absorbing root weights in particular had increased in the top layer since the second examination, and differentiation was evidently rapid in primary roots during this period. Over all varieties there was an increase in actual weight of absorbing roots since the second examination, although the percentage of absorbing roots in the total root weight was now less. This was explained by a transition of absorbing roots to non-absorbing roots which was now taking place. Actual evidence of this transition could be seen where old roots had evidently lost fibrous roots, and were now no longer of any apparent value as absorbing roots. The most notable varietal differences at this time were the great increase in the root mass of B.H.10(12), with its particularly marked development of absorbing roots in the surface six-inch soil layer, the comparatively low total root weight in Ba.11569, which had also been a feature of the

previous examinations, and the high percentage of old, black, non-absorbing roots in P.O.J. 2878, and to a lesser extent in Co.281. The last observation suggests that the root systems of these varieties may complete their life cycle more rapidly than those of the Barbados varieties. If this is so, it is both of interest and of practical importance to note the association between the vegetative periodicities of the root systems and shoot systems in these varieties. Future work is being planned, as will be shown later, to investigate this aspect of the subject.

The crop season, 1934, was exceptionally dry, and at the fourth examination the old canes, particularly in the Barbados varieties, were drying out rapidly. In general the root systems were moribund, and many of the roots were rotting. On living roots the fibrous roots were withering, and it was difficult to estimate absorptive capacity of the roots from such fibrous roots as were seen. No new roots were being produced from the cane bases, and with soil moisture in the surface layers low again, the most recently produced roots had penetrated the lower soil vertically or obliquely as was seen at the first examination one year before. The relationship between stool composition and root development was clearly shown at this time. The extent of decay in the root systems was less evident in those stools which had produced and developed shoots at the end of the year in the early months of the dry season. These latter bore roots which penetrated deeply into the lower soil layers, and were evidently of great importance to the life of the stools at this time, as was shown by the comparative soundness of the older canes in such stools. Varietal differences in root systems at this time appeared to be chiefly related to the extent of production of late roots, which in turn was clearly related to the production of late shoots by the stools.

Conclusions from the investigation were that all roots arising from the tillers are fundamentally of one type, and that in their growth and development differentiation ensues to provide recognisable root types. The developmental changes in the root are described in the paper referred to above, and would appear to be relatively slow under conditions of low soil moisture, and more rapid when soil moisture is high. The effect of variety and of environmental condition on the rate of development in individual roots and on the growth of the root systems are also discussed in detail.

At present, analytical root system periodicity studies are being carried on, and it is intended to repeat the type of investigation described above, to note the root system development under the rainfall conditions of the season 1934—36.

II. GUMMING DISEASE INVESTIGATIONS.

(i) Introduction.

Gumming disease (*Bacterium vascularum* (Cobb) Greig Smith) of sugar cane occurs in Barbados, Antigua, St. Kitts and St. Lucia of the British West Indies sugar producing islands. It is absent in Trinidad and Jamaica. Breeding for resistance to gumming disease is consequently of importance

in the production of improved varieties by the British West Indies Central Sugar Cane Breeding Station.

Gumming disease manifests itself in two ways in a susceptible variety; (1) leaf symptoms, which result in the destruction of more or less assimilating tissue, and are easily recognised in the field, and (2), systemic infection, which involves bacterial invasion of the cane and the production of gum, and may result in the actual death of canes or interference with the sugar manufacturing processes at the factory. The second aspect of the disease is the more serious one from the commercial point of view.

In Barbados, although leaf symptoms occur wherever susceptible varieties are grown, and death of canes has been seen in some cases resulting from the disease, there has been up to the present time no suspected case of infected cane causing interference with factory processes. Nevertheless, it is realised that the growing of highly susceptible varieties is a bad practice, not only because the disease may, under certain environmental conditions, assume its more serious aspect, but also because they form a continuous bombarding medium for other less susceptible varieties.

The following is a short account of the experiments which are being carried out on gumming disease in Barbados, and of which it is hoped to publish a full account in the near future.

(ii) The Relationship Between Leaf Symptom Intensities and Systematic Infection (Production of Gum in the Canes).

The object of this investigation was to ascertain in how far the extent of leaf symptom development in the field may be taken to represent the extent of systemic infection in a variety. The importance of this lies in the ease with which varietal comparisons of susceptibility may be made in new seedlings at an early stage of their trials.

Twenty varieties, which embraced a wide range in susceptibility to leaf symptoms, were planted in four blocks, with rows of the highly susceptible variety Ba.11569 between and around them to provide infective material.

Leaf symptoms were recorded at weekly intervals from June, 1933, until January, 1934. This was done by eye estimates of comparative development of leaf symptoms, employing the same observers throughout, to effect, as far as possible, uniformity in assessing the leaf symptom intensities.

Systemic infection was recorded by noting the gum exudation taking place from the ends of pieces of the cut canes which had been maintained for one day in a saturated atmosphere. Special boxes were used for this purpose, and, in each variety, canes showing typical leaf symptoms, and free from moth borer damage, were selected. Nine such examinations were made between October and January. While it was impracticable to ascertain the actual amount of gum exuding from the canes, comparative figures were obtained by recording the numbers of gum globules of three size categories for each variety.

Conclusions from the investigation are that, in general, varieties which are highly susceptible to leaf symptoms show also a high degree of systemic infection. There were exceptions to this—notably the variety Ba.11569, which showed very low systemic infection—but in no case was a variety seen to exhibit any marked degree of systemic infection unless the development of leaf symptoms was considerable.

Consequently, for the present, it is considered that varieties showing little or no leaf symptoms may, for practical purposes, be regarded as resistant to the disease, while there is at least a probability that those exhibiting considerable leaf symptoms are also susceptible to the more serious aspect of the disease. These conclusions are to be further tested in a similar type of experiment during season 1934-36.

(iii) The Inheritance of Gumming Disease Resistance.

Routine weekly observations of leaf symptom development in varieties have been made for four seasons, and are being continued. These records are made in the multiplication plots of selected seedlings, in the second year seedling trials, and in the collections of varieties whose susceptibility to the disease has not been previously recorded. In all cases the plots are interplanted with the susceptible variety Ba.11569, to provide infective material. Up to the present time the susceptibility of more than three hundred varieties to the disease in Barbados is known, and from these figures it is possible to study the inheritance of gumming disease resistance by calculating resistance fractions for populations from particular parentages.

Crosses which throw a high percentage of susceptible seedlings are eliminated from the breeding programme. An example of this is the cross Ba.11569 by Ba.6032, the seedlings from which show a very high percentage of susceptible individuals. As a result this cross will no longer be made.

(iv) Future Work.

Experiments, similar to the above, will be made during season 1934-36.

**EXPENDITURE ON BRITISH WEST INDIES CENTRAL SUGAR CANE
BREEDING STATION FOR THE YEAR ENDING
30TH SEPTEMBER, 1933.**

Recurrent:—						£	s.	d.
Personal Emoluments	..	..	..	..	..	679	14.	2.
Seedling Trials, &c.	..	..	..	..	..	177	0.	8.
Travelling	..	..	..	..	..	261	7.	10.
Contingencies	..	..	..	..	..	50	5.	1.
						<u>1,168</u>	<u>7.</u>	<u>9.</u>
Capital:—						£	s.	d.
Scales	..	..	..	..	..	60	0.	0.
Office Equipment, including Adding Machine	..	..	..	..	..	91	19.	9.
Irrigation Gutters	..	..	..	..	..	202	3.	4.
						<u>354</u>	<u>3.</u>	<u>1.</u>
Totals:—						£	s.	d.
Recurrent	..	..	..	..	..	1,168	7.	9.
Capital	..	..	..	..	..	354	3.	1.
						<u>1,522</u>	<u>10.</u>	<u>10.</u>

**EXPENDITURE ON BRITISH WEST INDIES CENTRAL SUGAR CANE
BREEDING STATION FOR THE YEAR ENDING
30TH SEPTEMBER, 1934.**

Recurrent:—						£	s.	d.
Personal Emoluments	..	..	..	..	..	834	16.	6.
Seedling Trials, &c.	..	..	..	..	..	377	0.	2.
Travelling	..	..	..	..	..	331	7.	9.
Contingencies	..	..	..	..	..	22	11.	9.
						<u>1,565</u>	<u>16.</u>	<u>2.</u>
Capital:—						£	s.	d.
Purchase of Lorry	..	..	..	..	..	200	5.	0.
Alterations to Garage	..	..	..	..	..	45	8.	7.
Purchase of Plates for publication of Dr. McIntosh's Report on Growth Measurements.						50	9.	4.
Installation of Pipe Track and other necessary Capital Expenditure which may arise						156	8.	11.
						<u>452</u>	<u>11.</u>	<u>10.</u>
Totals:—						£	s.	d.
Recurrent	..	..	..	..	..	1,565	16.	2.
Capital	..	..	..	..	..	452	11.	10.
						<u>2,018</u>	<u>8.</u>	<u>0.</u>

